# BPM Processing Options

## FETS Meeting 13-02-2013

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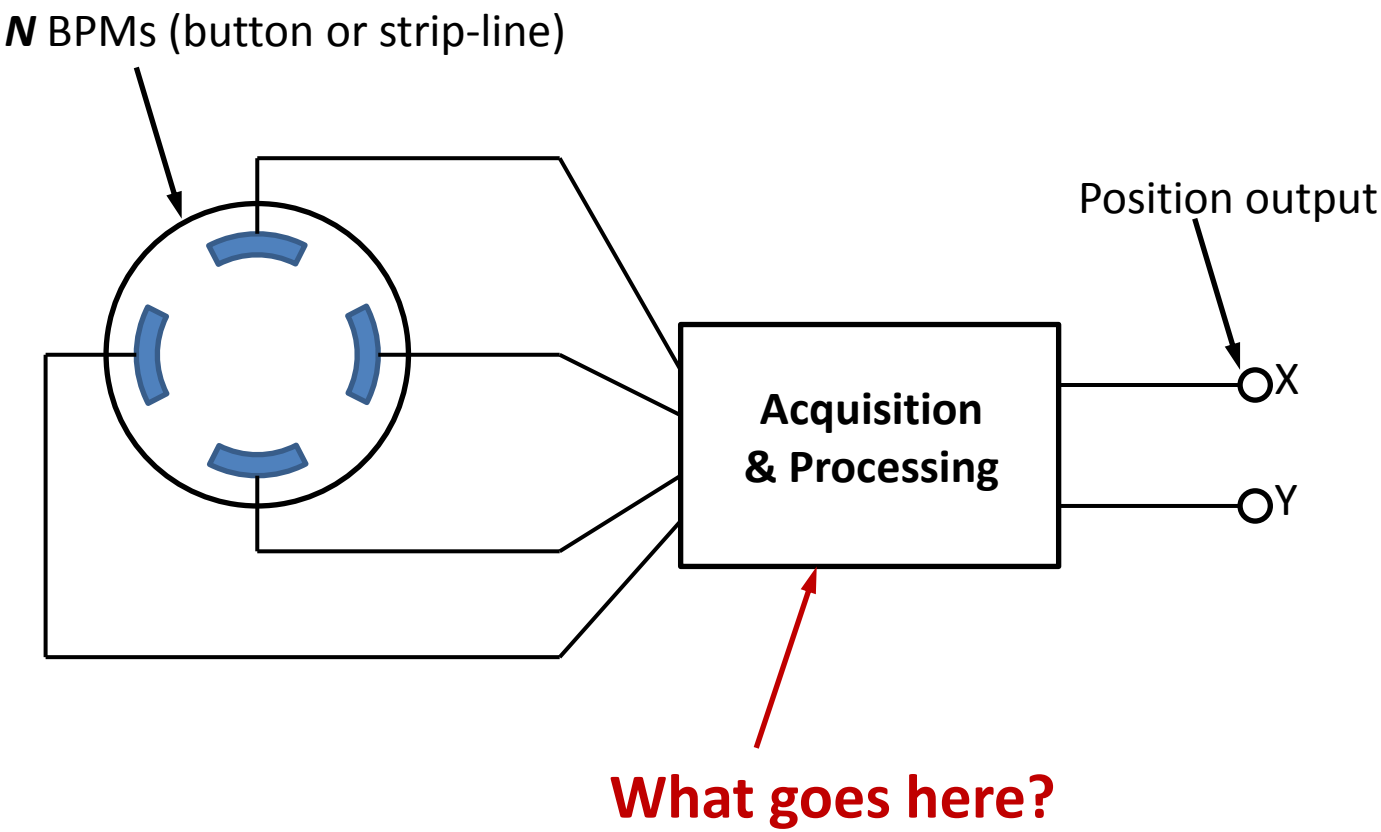
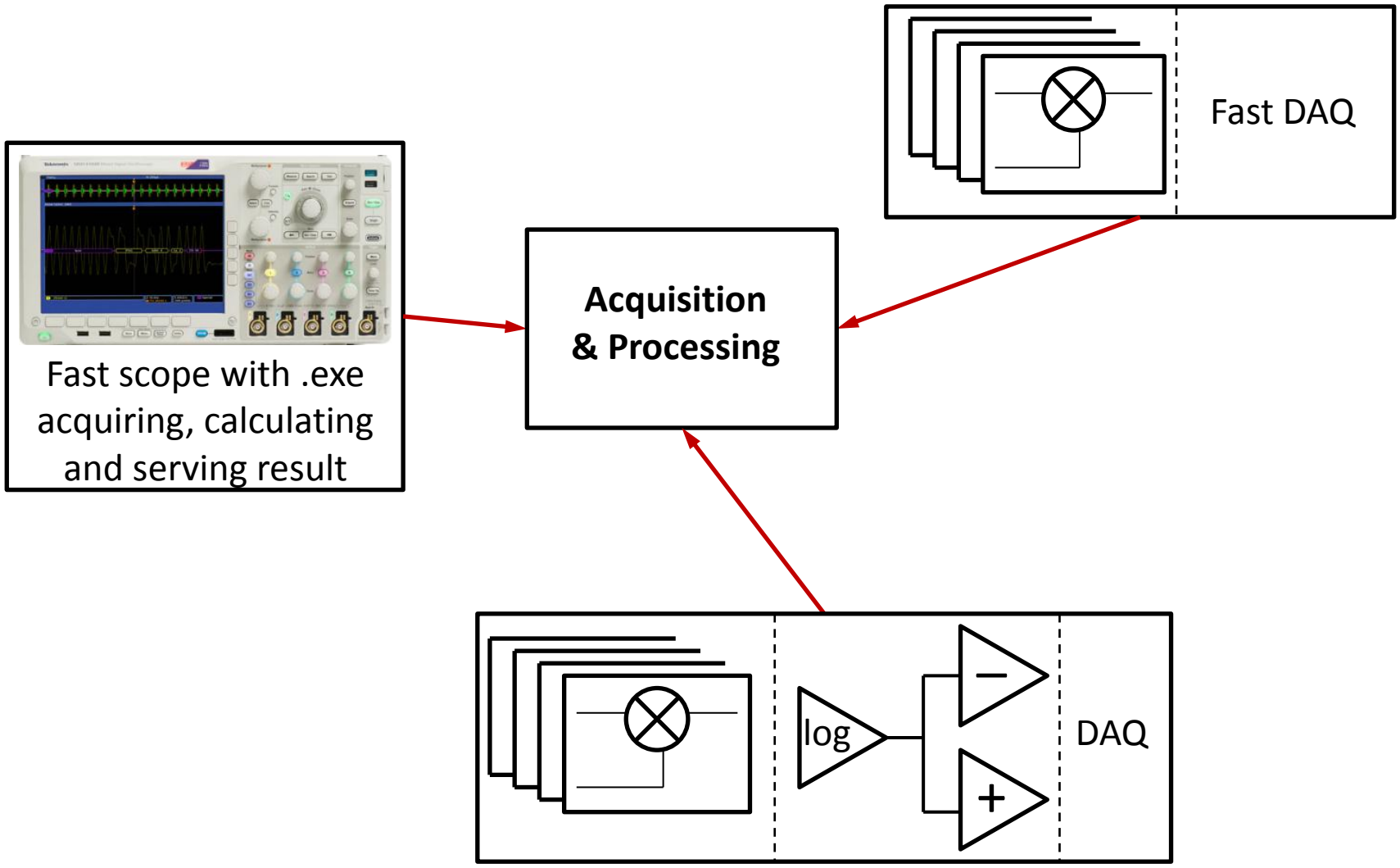
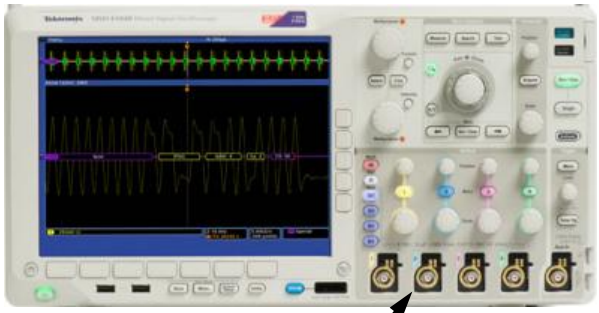
# BPM Processing



# BPM Processing Outline Options



# BPM Processing – Fast Scope



BPM Signals In

- Can run processing SW and server on higher-end scope. eg Tektronix 5000 series or higher, but cost ~£10k/scope!

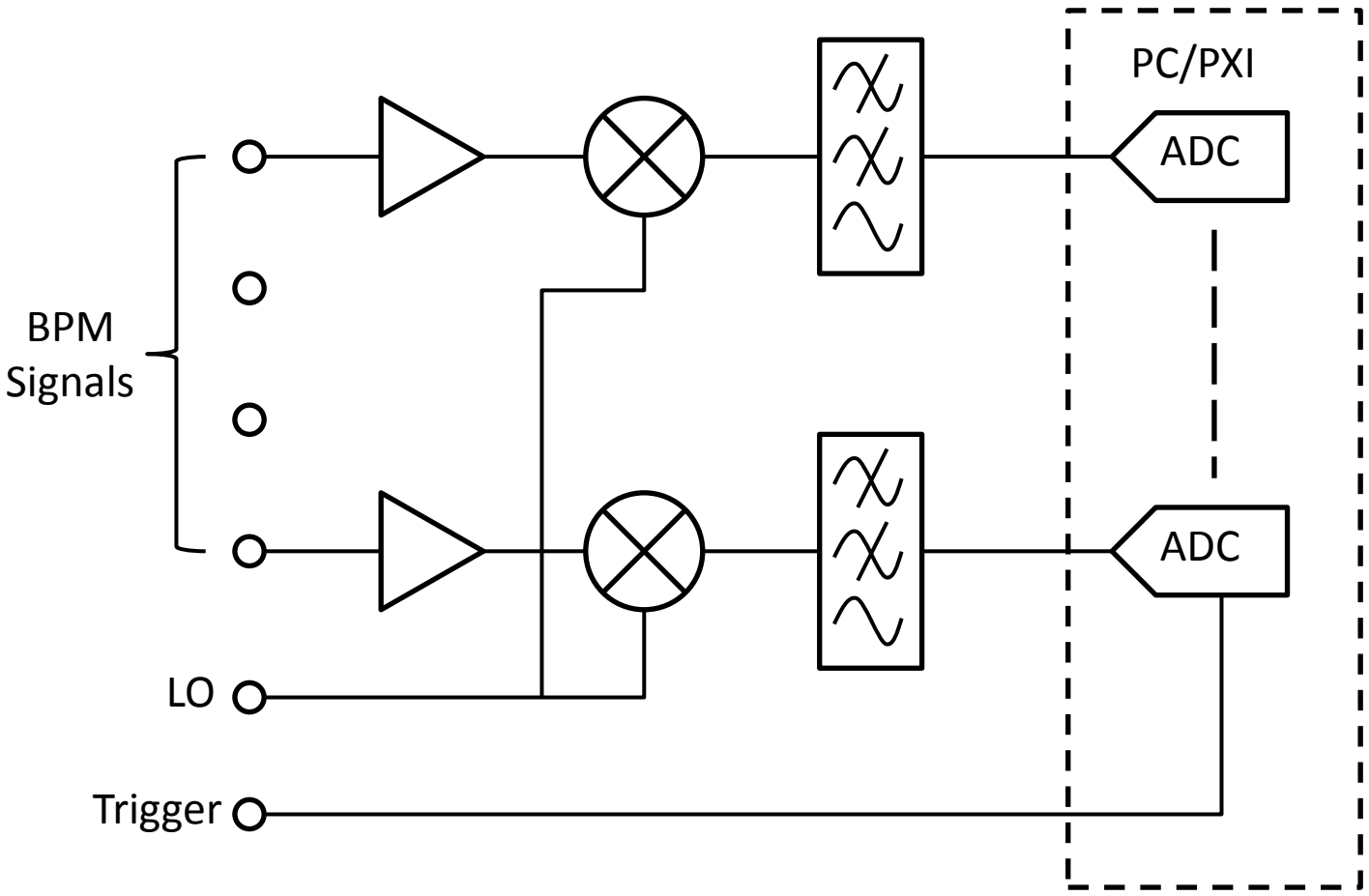
- Could acquire data on mid-range scope, then move data over network to PC for processing.

- eg 350MHz 4-channel scope ~£7k .

- Similar spec scopes are similar prices whatever the manufacturer.

- Fairly expensive option but reasonably quick to implement.

# BPM Processing – Down Conversion and DAQ



# BPM Processing – Down-Conversion Options

- **Bergoz (BPM-AFE) card**
  - Four Channels (one BPM)
  - LO: 10-100MHz
  - Includes Calibration Tone input
  - Balanced signal out (ground loop elimination)
  - Cost: £1.8k per card, but requires some mounting hardware (~£500)
  - Delivery time 14 weeks ARO
- **Self-made Connectorised Front-End**
  - Use connectorised elements from Hititte, Mini-circuits etc
  - Join elements using SMA connectors and RG174 cable
  - Easy testing and development
  - Requires some design effort
  - Cost ~£1k per BPM
- **Self-made RF PCB**
  - Use RF IC components
  - Compact and cheap £200-300 per BPM
  - Long design and testing schedule

# BPM Processing – DAQ/Digitizing Options

- **Data Acquisition Cards**
  - Acquire at tens of MS/s per channel within PXI system
  - Move data to PXI processor card and obtain position
  - Resultant positions served via IOC
  - Cost £4k per eight channels (4 per BPM) eg PXI-5105, 12-bit
- **Digitizer and FPGA**
  - Use FPGA with Digitizer front-end within PXI system
  - Digitizer 50MS/s 32 channel (diff), 12-bit, simultaneous sample
  - Can do processing within FPGA and pass result to processor and serve via IOC
  - PXI-based FPGA card with breakout box
  - Cost £7-10k, depending on FPGA size required (work is ongoing) including digitizer, FPGA, breakout box, cable
  - Very fast position calculation
- **'Slow' Oscilloscopes**
  - Could digitize using a low BW scope
  - Have to move data across network at 40MByte/s for four BPMs! This will seriously load gigabit ethernet – not recommended!
  - Cost £4-8k depending on scope selected.

# BPM Processing – Analogue Position Processing

- **Bergoz LR-BPM**
  - Analogue front-end providing analogue voltage output proportional to beam position; max rate 5MHz
  - Requires two DAQ channels per BPM
  - Fast position calculation
  - Cost £4.2k per BPM, with £1.5k for Bergoz rack-mount system
  - Options for direct mixed signal output, sum of all channels etc (~£200 per option)

# BPM Processing – Summary

- Optimum solution (cost, time to implement, position speed) depends on number of BPMs used…
- Solution fairly independent of BPM type (expected signal levels are required)
- One BPM:
  - Ditch the DPO4034B (currently on order) and buy DPO5000 series scope for onboard position processing
  - BPM-AFE, with the 1GS/s digitizers already in the PXI system
- Two BPMs: PXI DAQ with connectorised front-end
- Three/Four BPMs: FPGA digitizing with either BPM-AFE or connectorised front-end
- Cost could be reduced by £*few* k: develop/test connectorised front-end, then transfer to PCB. Takes extra few weeks.

❖ Extensive experience of BPM RF front-end design (L, S, C, X-band) at RHUL so 324MHz well within capabilities

❖ Extensive experience of Digitizers, FPGA, EPICS at RHUL